IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	:	
Dean P. Swoboda et al.	:	Examiner: M..A. Patterson
U.S. Serial No. 10/004,874	:	Group Art Unit: 1772
Filed December 7, 2001	:	
Docket No. 2251 (FJ-00-9)	:	
For: HIGH GLOSS DISPOSABLE PRESSWARE	:	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

DECLARATION OF DEAN P. SWOBODA

Sir:

Dean P. Swoboda, first-named inventor in the above-noted patent application, hereby declares:

1. That he was educated in pulp and paper technology and holds a Bachelor's Degree in Operation Management from Marian College, Fond du Lac, Wisconsin. He has worked in connection with disposable paper products for 20 years and is familiar with the subject matter of the above-noted patent application as well as the Office Action dated March 28, 2003. He understands that the claims have been rejected on various grounds, including that certain terminology was objected to. That he has also been advised that the claims were rejected over United States Patent No. 5,776,619 to *Shanton*, with which he is also familiar.

2. That with respect to terminology such as "formed in a heated die set", "prepared from a paperboard blank" and so forth objected to in the Office Action, one of skill in the art would readily understand that language to refer to an article press-formed from paperboard stock. Equipment to form paperboard containers is likewise well known as detailed in pages 10-16 of the above-noted patent application. The process involves positioning a paper blank, which is typically planar, in a reciprocating heated die set and then pressing the container into shape under heat and mechanical pressure. The process is specifically illustrated in **Figures 3** and **4** of the above-noted patent application. One of skill in the art would understand the language because there are only two types of shaped disposable paper food containers – press-formed and pulp-molded. The claim language thus distinguishes one type of shaped paper container from the other. Adding language to the effect that the claimed articles are press-formed further reinforces the distinction.

3. That he further understands that the Examiner has objected to the reference to ASTM Test Method ASTM D-523-89 because it may change with time. That objection is believed unwarranted since the "89" is a version designation referring to the year the test method was adopted. *See* Exhibit 1 hereto which is a copy of "Search Tips" from the ASTM site. The last paragraph instructs a user <u>not</u> to enter the date if the most recent test method version is desired.

4. That he is attaching a copy of ASTM D523-89 hereto as Exhibit 2. He understands that this document will be made of record in this patent application and that upon issuance of the patent anyone desiring access to the file will also have access to the Exhibit 2 document.

5. With respect to the '619 patent, the reference is believed only of general interest because it relates to relatively highly filled, heavy coatweight clay coatings applied to paperboard, not finish coatings as are claimed in the above-noted patent application. In this respect, it is noted in Col. 4, lines 7 and following of *Shanton* '619 that each coat is applied in an amount of from 4 to 12 lbs. per 3000 square foot ream, an

aggregate of 8 to 24 lbs. Note also, Col. 9, Examples 1 and 2 of the *Shanton* '619 patent below, where it is seen the coatings consist predominantly (80%) of clay pigment and/or mineral filler.

EXAMPLE 1			
Base Coat			
Pigment:	Huber Hydrasperse (kaolin clay)	80	parts
	ECCI Carbital 35	20	parts
Latex:	BASF ACRONAL S504	20	parts
Dispersant:			
	Dispex N40	0.12	parts
Top Coat			
Pigment:	ECCI KAOCARB	100	parts
Latex:	BASF ACRONAL S504	19	parts
Dispersant:			

EXAMPLE 2			
Base Coat			
Pigment:	ECCI KAOCARB 5	100	parts
Latex:	Latex:		
Dispersant:			
	Dispex N40	0.1	parts
Top Coat			
Pigment:	ECCI KAOCARB 5	100	parts
Latex:	Latex		
Dispersant:			
	Dispex N40	0.1	parts

6. On the other hand, coatings of the invention typically have no filler at all (but may contain some in some embodiments) and exhibit gloss values that are unexpectedly high, as is seen in Tables 2 and 3 at page 18 of the above-noted patent application as filed:

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Table 2 – Comparison of Gloss SBR/Acrylic vs. Acrylic/Acrylic

Example	Base Coat Type	Base Finish Coat Amount #/rm	Top Finish Coat Type	Top Coat Amount #/rm	Gloss 60 Degree, units Die positions 1-5 Average (Std. Dev)
1	Existing Acrylic	0.55	Existing Acrylic (Control)	0.50	25 (1.5)
2	Tykote	0.55	Michelman 706	0.60	50 (1.3)
3	Tykote	0.35	Cork 6979a	0.61	31 (2.7)

Table 3 – Comparison of Gloss SBR/Acrylic vs. Acrylic/Acrylic

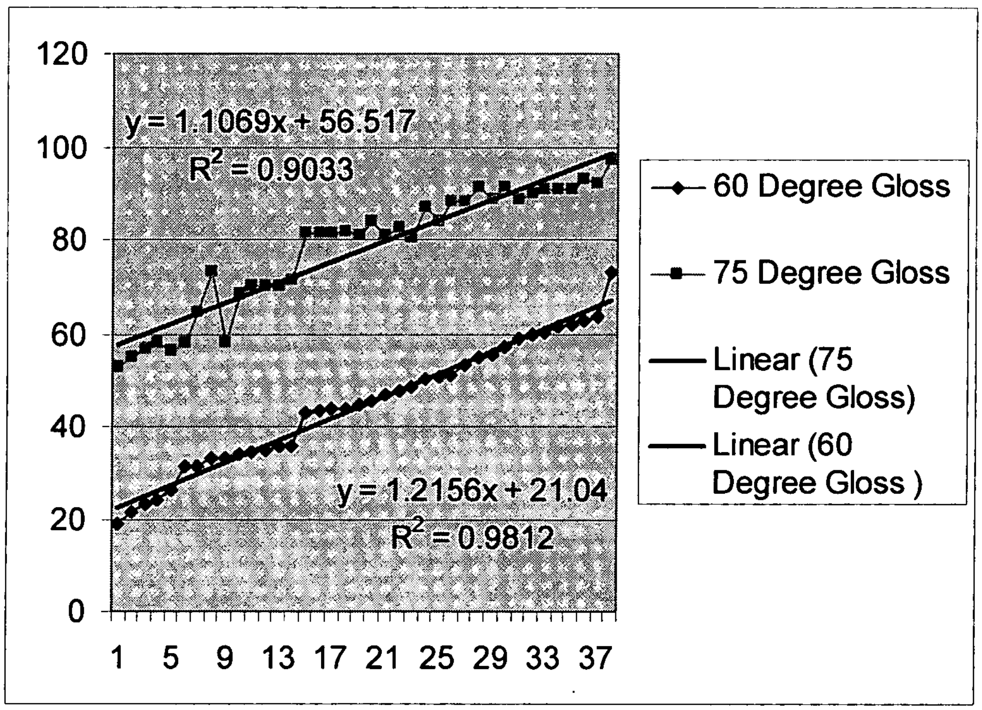
EXAMPLE	BASE FINISH COAT TYPE	Base Finish Coat Amount #/rm	TOP FINISH COAT TYPE	Top Coat Amount #/rm	Gloss 60 Degree, units Average
4	Existing Acrylic	0.61	Existing Acrylic (Control)	0.57	31
5	Tykote	0.73	Cork 6979a	0.56	55
6	Existing Acrylic	0.61	Existing Acrylic (Control)	0.61	29
7	Tykote	0.81	Michelman 706	0.60	57

7. As is seen in Tables 2 and 3, gloss values of 50 or more at 60 degrees are readily achieved with the invention. This is a surprising result which is not remotely suggested by *Shanton* '619 as further discussed below. It is further noted that the controls of the same paperboard are under 30 gloss units at 60 degrees.

8. *Shanton* '619 notes at Col. 4, lines 50 and following that coatings including styrene-butadiene resins formed poor barriers, especially with respect to grease. See also, Table 2 of *Shanton* '619, last entry, wherein a grease failure rate of 68% is reported for coatings including styrene-butadiene resins(defined as such in Col. 7, lines 58-

59). *Shanton* '619 does report gloss values at 75 degrees for a presumeably highly filled styrene-butadiene coating of 64.8 (machine direction) and 53.1 (cross machine direction) which values correspond to much less than 40 gloss units at 60 degrees, as discussed further below. Other, higher gloss coatings are also reported in Col. 8, Table 2 of *Shanton* '619. The maximum gloss value reported in *Shanton* '619 is 74.8 for the 75 degree method, machine direction.

9. In order to compare 75 degrees and 60 degrees gloss values, I compared data from a variety of sources and found a correlation to be as set forth below:



It is seen from the graph that a gloss value of about 75 at 75 degrees is roughly equivalent to a gloss value of about 40 at 60 degrees. Thus, even in a very different highly filled system, *Shanton* '619 does not achieve gloss values of more than 45 at 60 degrees. Gloss values of 64.8 and 53.1 at 75 degrees (last entry, Table 2 of *Shanton* '619) for the highly filled styrene/butadiene coating correspond to gloss

values at 60 degrees of less than 25 based on the above data (about 23.5 and 10.65 based on the linear correlation).

10. The undersigned Declarant declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the subject application or any patent issuing thereon.

Dated 7/1/03

Dean P Swoboda
Dean P. Swoboda

Search Tips

There are two ways to search ASTM standards:

Search by ASTM Designations

You can search ASTM standards by entering the alphanumeric designation of the standard that you wish to access, e.g., **A961**.

If you are unsure of the complete designation, you can enter an asterisk (*) as a wild card. For example:

> **A96*** will yield A960, A961, etc...
> **A9*1** will yield A901, A911, etc...

Optionally, you can use the **Browse by Interest Area** or **Alphanumeric Listing of Standards** to browse the designations and titles of ASTM standards in a particular series. These link to the document summaries of the individual ASTM standards.

When searching standards, <u>do not</u> indicate the date in your designation search. For example, **E1527-97**, a standard that was revised in 1997, should be entered as "**E1527**." The <u>most recent</u> published version will always be retrieved.

Designation: D 523 – 89 (Reapproved 1999)

Standard T st M thod for Specular Gloss[1]

This standard is issued under the fixed designation D 523; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the measurement of the specular gloss of nonmetallic specimens for glossmeter geometries of 60, 20, and 85° **(1-7)**.[2]

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[3]

D 3964 Practice for Selection of Coating Specimens for Appearance Measurements[3]

D 3980 Practice for Interlaboratory Testing of Paint and Related Materials[4]

D 4039 Test Method for Reflection Haze of High-Gloss Surfaces[3]

E 97 Test Method for Directional Reflectance Factor, 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry[5]

E 430 Test Method for Measurement of Gloss of High-Gloss Surfaces by Goniophotometry[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *relative luminous reflectance factor*—the ratio of the luminous flux reflected from a specimen to the luminous flux reflected from a standard surface under the same geometric conditions. For the purpose of measuring specular gloss, the standard surface is polished glass.

3.1.2 *specular gloss*—the relative luminous reflectance factor of a specimen in the mirror direction.

4. Summary of Test Method

4.1 Measurements are made with 60, 20, or 85° geometry **(8, 9)**. The geometry of angles and apertures is chosen so that these procedures may be used as follows:

4.1.1 The 60° geometry is used for intercomparing most specimens and for determining when the 20° geometry may be more applicable.

4.1.2 The 20° geometry is advantageous for comparing specimens having 60° gloss values higher than 70.

4.1.3 The 85° geometry is used for comparing specimens for sheen or near-grazing shininess. It is most frequently applied when specimens have 60° gloss values lower than 10.

5. Significance and Use

5.1 Gloss is associated with the capacity of a surface to reflect more light in some directions than in others. The directions associated with mirror (or specular) reflection normally have the highest reflectances. Measurements by this test method correlate with visual observations of surface shininess made at roughly the corresponding angles.

5.1.1 Measured gloss ratings by this test method are obtained by comparing the specular reflectance from the specimen to that from a black glass standard. Since specular reflectance depends also on the surface refractive index of the specimen, the measured gloss ratings change as the surface refractive index changes. In obtaining the visual gloss ratings, however, it is customary to compare the specular reflectances of two specimens having similar surface refractive indices. Since the instrumental ratings are affected more than the visual ratings by changes in surface refractive index, non-agreement between visual and instrumental gloss ratings can occur when high gloss specimen surfaces differing in refractive index are compared.

5.2 Other visual aspects of surface appearance, such as distinctness of reflected images, reflection haze, and texture, are frequently involved in the assessment of gloss **(1)**, **(6)**, **(7)**. Test Method E 430 includes techniques for the measurement of both distinctness-of-image gloss and reflection haze. Test

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[1] This test method is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.03 on Geometry.

Current edition approved March 31, 1989. Published May 1989. Originally published as D 523 – 39 T. Last previous edition D 523 – 85$^{\epsilon 1}$.

[2] The boldface numbers in parentheses refer to the list of references at the end of this test method.

[3] *Annual Book of ASTM Standards*, Vol 06.01.

[4] Discontinued; see *1997 Annual Book of ASTM Standards*, Vol 06.01.

[5] Discontinued; see *1992 Annual Book of ASTM Standards*, Vol 14.02.

Method D 4039 provides an alternative procedure for measuring reflection haze.

5.3 Little information about the relation of numerical-to-perceptual intervals of specular gloss has been published. However, in many applications the gloss scales of this test method have provided discriminations between coated specimens that have agreed well with visual discriminations of gloss **(10)**.

5.4 When specimens differing widely in perceived gloss or color, or both, are compared, nonlinearity may be encountered in the relationship between visual gloss difference ratings and instrumental gloss reading differences.

6. Apparatus

6.1 *Instrumental Components*—The apparatus shall consist of an incandescent light source furnishing an incident beam, means for locating the surface of the specimen, and a receptor located to receive the required pyramid of rays reflected by the specimen. The receptor shall be a photosensitive device responding to visible radiation.

TABLE 1 Angles and Relative Dimensions of Source Image and Receptors

	In Plane of Measurement			Perpendicular to Plane of Measurement		
	θ,°	2 tan θ/2	Relative Dimension	θ, °	2 tan θ/2	Relative Dimension
Source image	0.75	0.0131	0.171	2.5	0.0436	0.568
Tolerance ±	0.25	0.0044	0.057	0.5	0.0087	0.114
60° receptor	4.4	0.0768	1.000	11.7	0.2049	2.668
Tolerance±	0.1	0.0018	0.023	0.2	0.0035	0.046
20° receptor	1.8	0.0314	0.409	3.6	0.0629	0.819
Tolerance ±	0.05	0.0009	0.012	0.1	0.0018	0.023
85° receptor	4.0	0.0698	0.909	6.0	0.1048	1.365
Tolerance±	0.3	0.0052	0.068	0.3	0.0052	0.068

6.2 *Geometric Conditions*—The axis of the incident beam shall be at one of the specified angles from the perpendicular to the specimen surface. The axis of the receptor shall be at the mirror reflection of the axis of the incident beam. The axis of the incident beam and the axis of the receptor shall be within 0.1° of the nominal value indicated by the geometry. With a flat piece of polished black glass or other front-surface mirror in the specimen position, an image of the source shall be formed at the center of the receptor field stop (receptor window). The length of the illuminated area of the specimen shall be not more than one third of the distance from the center of this area to the receptor field stop. The dimensions and tolerance of the source and receptor shall be as indicated in Table 1. The angular dimensions of the receptor field stop are measured from the receptor lens in a collimated-beam-type instrument, as illustrated in Fig. 1, and from the test surface in a converging-beam-type instrument, as illustrated in Fig. 2. See Fig. 1 and Fig. 2 for a generalized illustration of the dimensions. The tolerances are chosen so that errors in the source and receptor apertures do not produce an error of more than one gloss unit at any point on the scale **(5)**.

6.2.1 The important geometric dimensions of any specular-gloss measurement are:

6.2.1.1 Beam axis angle(s), usually 60, 20, or 85°.

6.2.1.2 Accepted angular divergences from principal rays (degree of spreading or diffusion of the reflected beam).

NOTE 1—The parallel-beam glossmeters possess the better uniformity of principle-ray angle of reflection, but the converging-beam glossmeters possess the better uniformity in extent of angular divergence accepted for measurement.

NOTE 2—*Polarization*—An evaluation of the impact of polarization on gloss measurement has been reported **(11)**. The magnitude of the polarization error depends on the difference between the refractive indices of specimen and standard, the angle of incidence, and the degree of polarization. Because the specimen and standard are generally quite similar optically, measured gloss values are little affected by polarization.

6.3 *Vignetting*—There shall be no vignetting of rays that lie within the field angles specified in Table 1.

6.4 *Spectral Conditions*—Results should not differ significantly from those obtained with a source-filter photocell combination that is spectrally corrected to yield CIE luminous efficiency with CIE source C. Since specular reflection is, in general, spectrally nonselective, spectral corrections need to be applied only to highly chromatic, low-gloss specimens upon agreement of users of this test method.

6.5 *Measurement Mechanism*—The receptor-measurement mechanism shall give a numerical indication that is proportional to the light flux passing the receptor field stop with

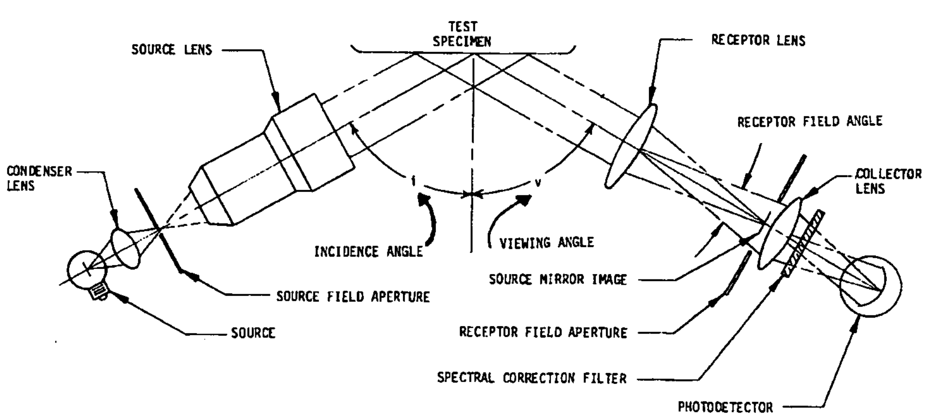

FIG. 1 Diagram of Parallel-Beam Glossmeter Showing Apertures and Source Mirror-Image Position

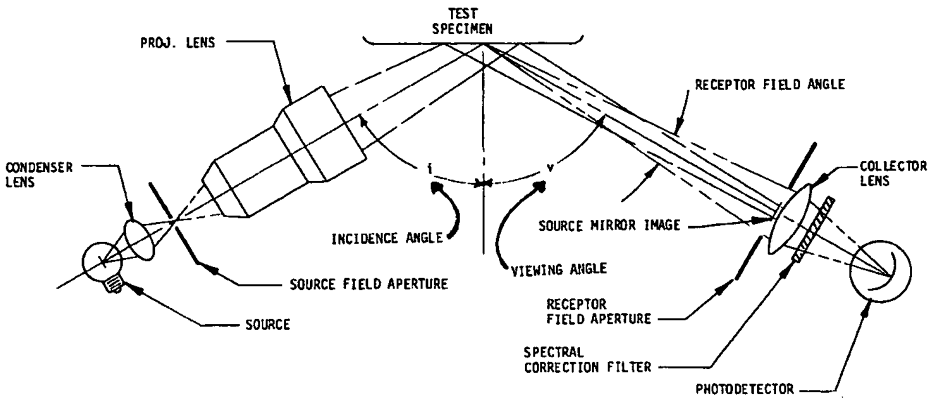

FIG. 2 Diagram of Converging-Beam Glossmeter Showing Apertures and Source Mirror-Image Position

±1 % of full-scale reading.

7. Reference Standards

7.1 *Primary Standards*—Highly polished, plane, black glass with a refractive index of 1.567 for the sodium D line shall be assigned a specular gloss value of 100 for each geometry. The gloss value for glass of any other refractive index can be computed from the Fresnel equation **(5)**. For small differences in refractive index, however, the gloss value is a linear function of index, but the rate of change of gloss with index is different for each geometry. Each 0.001 increment in refractive index produces a change of 0.27, 0.16, and 0.016 in the gloss value assigned to a polished standard for the 20, 60, and 85° geometries, respectively. For example, glass of index 1.527 would be assigned values of 89.2, 93.6, and 99.4, in order of increasing geometry.

NOTE 3—Polished black glass has been reported to change in refractive index with time largely due to chemical contamination **(10)**. The original values can be restored by optical polishing with cerium oxide. A wedge of high-purity quartz provides a more stable reference standard than glass.

7.2 *Working Standards*—Ceramic tile, depolished ground opaque glass, emery paper, and other semigloss materials having hard and uniform surfaces are suitable when calibrated against a primary standard on a glossmeter known to meet the requirements of this test method. Such standards should be checked periodically for constancy by comparing with primary standards.

7.3 Store standards in a closed container when not in use. Keep them clean and away from any dirt that might scratch or mar their surfaces. *Never* place standards face down on a surface that may be dirty or abrasive. Always hold standards at the side edges to avoid getting oil from the skin on the standard surface. Clean the standards in warm water and a mild detergent solution brushing gently with a soft nylon brush. (Do *not* use soap solutions to clean standards, because they can leave a film.) Rinse standards in hot running water (temperature near 150°F (65°C)) to remove detergent solution, followed by a final rinse in distilled water. *Do not wipe standards.* The polished black glass high-gloss standard may be dabbed gently with a lint-free paper towel or other lint-free absorbent material. Place the rinsed standards in a warm oven to dry.

8. Preparation and Selection of Test Specimens

8.1 This test method does not cover preparation techniques. Whenever a test for gloss requires the preparation of test specimens, use the procedures given in Practice D 823.

NOTE 4—To determine the maximum gloss obtainable from a test material, such as a paint or varnish, use Methods B or C of Practice D 823.

8.2 Select specimens in accordance with Practice D 3964.

9. Instrument Calibration

9.1 Operate the glossmeter in accordance with the manufacturer's instructions.

9.2 Verify the instrument zero by placing a black cavity in the specified position. If the reading is not within ±0.1 of zero, subtract it algebraically from subsequent readings or adjust the instrument to read zero.

9.3 Calibrate the instrument at the start and completion of every period of glossmeter operation, and during the operation at sufficiently frequent intervals to assure that the instrument response is practically constant. To calibrate, adjust the instrument to read correctly the gloss of a highly polished standard, properly positioned and oriented, and then read the gloss of a working standard in the mid-gloss range. If the instrument reading for the second standard does not agree within one unit of its assigned values, check cleanliness and repeat. If the instrument reading for the second standard still does not agree within one unit of its assigned value, repeat with another mid-range standard. If the disparity is still more than one unit, do not use the instrument without readjustment, preferably by the manufacturer.

10. Procedure

10.1 Position each specimen in turn beneath (or on) the glossmeter. For specimens with brush marks or similar texture effects, place them in such a way that the directions of the marks are parallel to the plane of the axes of the incident and reflected beams.

10.2 Take at least three readings on a 3 by 6-in. (75 by 150-mm) area of the test specimen. If the range is greater than two gloss units, take additional readings and calculate the mean after discarding divergent results as in the section on Test for Outliers of Practice D 3980. For larger specimens, take a proportionately greater number of readings.

11. Diffuse Correction

11.1 Apply diffuse corrections only upon agreement between the producer and the user. To apply the correction,

subtract it from the glossmeter reading. To measure the correction, illuminate the specimen perpendicularly and view at the incident angle with the receiver aperture specified in 6.2 for the corresponding geometry. To compute the correction, multiply the 45°, 0° directional reflectance of the specimen, determined in accordance with Test Method E 97, by the effective fraction of the luminous flux reflected by the perfect diffuse reflector and accepted by the receiver aperture. The luminous flux entering the receiver aperture from the perfect white diffusor would give the following gloss indications for each of the geometries:

Geometry, °	Gloss of Perfect White Diffuser
60	2.5
20	1.2
85	0.03

12. Report

12.1 Report the information following:

12.1.1 Mean specular gloss readings and the geometry used.

12.1.2 If uniformity of surface is of interest, the presence of any specimen that exhibits gloss readings varying by more than 5 % from their mean.

12.1.3 Where preparation of the test specimen has been necessary, a description or identification of the method of preparation.

12.1.4 Manufacturer's name and model designation of the glossmeter.

12.1.5 Working standard or standards of gloss used.

13. Precision

13.1 On the basis of studies of this test method by several laboratories in which single determinations were made on different days on several ceramic tiles and painted panels differing in visually perceived gloss, the pooled within-laboratory and between-laboratories standard deviations were found to be those shown in Table 2. Based on these standard deviations, the following criteria should be used for judging the acceptability of results at the 95 % confidence level:

13.1.1 *Repeatability*—Two results, each of which are single determinations obtained on the same specimen by the same operator, should be considered suspect if they differ by more than the maximum acceptable differences given in Table 3.

TABLE 2 Standard Deviation of Gloss Determinations

Type of Gloss,°	No. of Ceramic Tiles	Degrees of Freedom		Standard Deviations	
		Within-Laboratory	Between-Laboratories	Within-Laboratory[A]	Between-Laboratories[B]
20	4	40	34	0.4	1.2
60	4	40	34	0.3	1.2
85	2	16	6	0.2	0.6
Type of Gloss,°	**No. of Painted Panels**	**Degrees of Freedom**		**Standard Deviations**	
		Within-Laboratory	Between-Laboratories	Within-Laboratory[A]	Between-Laboratories[B]
20	8	80	72	0.6	2.2
60	22	220	136	0.3	1.2
85	6	48	18	0.3	2.4

[A] Single determinations.
[B] For means of three determinations.

TABLE 3 Maximum Acceptable Differences for Two Results

Type of Gloss,°	Repeatability (Within Laboratories)[A]		Reproducibility (Between Laboratories)[B]	
	Ceramic Tiles	Painted Panels	Ceramic Tiles	Painted Panels
20	1.1	1.7	3.5	6.4
60	0.9	0.9	3.4	3.5
85	0.6	0.8	2.0	7.2

[A] Single determinations.
[B] For means of three determinations.

13.1.2 *Reproducibility*—Two results, each the mean of three determinations, obtained on the same specimen by different laboratories should be considered suspect if they differ by more than the maximum acceptable differences given in Table 3. This does not include variability due to preparation of panels in different laboratories.

NOTE 5—For some types of paint, particularly semi-gloss, the measured gloss is affected by method of film preparation and drying conditions so that the reproducibility of results from such materials may be poorer than the values given in Table 3.

14. Keywords

14.1 appearance; directional reflectance factor; gloss; goniophotometry; high gloss; relative luminous reflectance factor; specular gloss

REFERENCES

(1) Hunter, R. S., "Methods of Determining Gloss," *Proceedings, ASTM*, Vol 36, 1936, Part II, p. 783. Also, *Journal of Research*, Nat. Bureau Standards, Vol 18, No. 1, January 1937, p. 19 (*Research Paper RP958*). Six somewhat different appearance attributes are shown to be variously associated with gloss. Therefore, as many as six different photometric scales may be required to handle all gloss measurement problems. (This paper is out of print).

(2) Hunter, R. S., and Judd, D. B., "Development of a Method of Classifying Paint According to Gloss," *ASTM Bulletin*, No. 97, March 1939, p. 11. A comparison is made of several geometrically different photometric scales for separating paint finishes for gloss. The geometric conditions of test later incorporated in Test Method D 523 are recommended.

(3) Wetlaufer, L. A., and Scott, W. E., "The Measurement of Gloss," *Industrial and Engineering Chemistry*, Analytical Edition, Vol 12, November 1940, p. 647. A goniophotometric study of a number of paint finishes illuminated at 45°; a study of gloss readings affected by variation of aperture for 45 and 60° incidence.

(4) Hunter, R. S.," The Gloss Measurement of Paint Finishes," *ASTM Bulletin*, No. 150, January 1948, p. 72. History of Test Method D 523.

(5) Hammond, H. K., III, and Nimeroff, I., "Measurement of Sixty-Degree Specular Gloss," *Journal of Research*, Nat. Bureau Standards. A study of the effect of aperture variation on glossmeter readings, including definitions of terms used in connection with specular gloss measurement, the Fresnel equation in a form readily usable for computation, and the deviation of diffuse correction formulas.

(6) Hunter, R. S., "Gloss Evaluation of Materials," *ASTM Bulletin*, No. 186, December 1952, p. 48. A study of the history of gloss methods in ASTM and other societies, describing the background in the choice of geometry of these methods. Contains photographs depicting gloss characteristics of a variety of methods.

(7) Hunter, R. S., *The Measurement of Appearance*, Wiley-Interscience,

New York, 1975, Chapter 6, "Scales for Gloss and Other Geometric Attributes," and Chapter 13," Instruments for the Geometric Attributes of Object Appearance."

(8) Horning, S. C., and Morse, M. P., "Measurement of the Gloss of Paint Panels," *Official Digest*, Federation of Paint and Varnish Production Clubs, March 1947, p. 153. A study of the effect of geometric conditions on results of gloss tests with special attention to high-gloss panels.

(9) Huey, S., Hunter, R. S., Schreckendgust, J. G., and Hammond, H. K., III, "Symposium on Gloss Measurement," *Official Digest*, Vol 36, No. 471, April 1964, p. 343. Contains discussion of industrial experience in measurement of 60° specular gloss (Huey), high-gloss measurement (Hunter), evaluation of low-gloss finishes with 85° sheen measurements (Schreckendgust), and gloss standards and glossmeter standardization (Hammond).

(10) Billmeyer, F. W., Jr., O'Donnell, F. X. D., "Visual Gloss Scaling and Multidimensional Scaling Analysis of Painted Specimens," *Color Research and Application*, Vol 12, 1987, pp 315–326. Compares visual difference ratings with instrumental measurements of specular gloss, distinctness of image gloss, and haze for series of black, gray, and white painted specimens. The data are analyzed by multidimensional scaling.

(11) Budde, W., "Stability Problems in Gloss Measurements," *Journal of Coatings Technology*, Vol 52, June 1980, pp. 44–48.